

## **“SMART SKIES”**

### **Airspace Systems—Predicting Air Traffic Conflicts**

#### ***An Introduction for Teachers, Grades 5-8***

## **OVERVIEW**

### **Airspace Systems “Smart Skies” Curriculum Supplements**

*Curriculum Supplement 0 serves as an introduction to “Smart Skies.” It features activities based upon only one airplane.*

The “Smart Skies” curriculum materials have been developed by NASA’s Airspace Systems Program to engage students in Grades 5-8 in real-life applications of mathematics and science. The Airspace Systems program develops advanced computer-based systems to help pilots and air traffic controllers operate the nation’s air transportation system with reduced flight delays and improved efficiency and access. Using the “Smart Skies” curriculum materials, your students learn to predict air traffic conflicts using distance, speed, and time relationships.

Each of the eight “Smart Skies” Curriculum Supplements examines a different air traffic scenario that an air traffic controller might encounter.

In Curriculum Supplements 1 through 6, the controller must track two airplanes flying at the same altitude on merging jet routes to avoid a conflict. Curriculum Supplements 7 and 8 address two airplanes on the same jet route, with the trailing airplane traveling faster than the leading airplane. In each Curriculum Supplement, each airplane travels at a constant (fixed) speed.

The Curriculum Supplements build upon one another and typically use the same sets of parameters (distances, speeds, and separation distances).

In each Curriculum Supplement, students can:

- Assume the role of a NASA engineer and use guided paper-and-pencil activities to determine the number of seconds it takes each plane to travel a given distance along a jet route.

- Assume the roles of pilots, air traffic controllers, and engineer observers to conduct an experiment that simulates the airplane scenario.

The eight air traffic scenarios are summarized in the following table.

### Summary of the “Smart Skies” Airspace Systems Scenarios

Curriculum Supplements 1 – 6			
Two planes are traveling on <b>different</b> jet routes. <b>Will they conflict</b> at the intersection of their routes? If so, which plane arrives first and when?			
Curriculum Supplement	Distance from Intersection of Routes (Same/Different)	Speed (Same/Different)	Separation Requirement at Intersection of Routes? (Yes/No)
1	Same	Same	No
2	Different	Same	No
3	Different	Same	Yes
4	Different	Same	Yes <i>Separation violation □ alternate route □ new intersection</i>
5	Same	Different	Yes <i>Separation violation □ different speeds</i>
6	Different	Different	Yes
Curriculum Supplements 7 – 8			
Two planes are traveling on the <b>same</b> jet route. The following plane is going faster than the leading plane. <b>When will the planes conflict?</b>			
Curriculum Supplement	Distance from Intersection of Routes (Same/Different)	Speed (Same/Different)	Separation Requirement? (Yes/No)
7	Different	Different	No
8	Different	Different	Yes

## Goals

The “Smart Skies” Airspace Systems series has two overarching goals:

- To enable students to use mathematical reasoning and scientific inquiry to investigate and solve problems based on real-life scenarios.
- To offer students a variety of problem-solving tools and approaches, ranging from experiments to paper-and-pencil activities.

## Science Standards

*For a comprehensive alignment to the NSES, see **Appendix A** of this document.*

Each “Smart Skies” Curriculum Supplement supports several of the National Science Education Standards (NSES) for Grades 5-8.

In particular, the “Motion and Forces” Physical Science content standard is a key focus of each Curriculum Supplement:

*“As a result of their activities in grades 5-8, all students should develop an understanding of motions and forces.”*

The NSES cites this fundamental concept that underlies the standard:

*“The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.”*

To address this concept, the Curriculum Supplement activities employ a variety of representations and techniques including tables, one-dimensional graphs, two-dimensional graphs, and experimentation.

In addition to the Physical Science content standard, each “Smart Skies” Curriculum Supplement supports Science as Inquiry Content Standard A:

*“As a result of activities in grades 5-8, all students should develop abilities necessary to do scientific inquiry.”*

In particular, each Curriculum Supplement provides opportunities for students to:

- *“Use appropriate tools and techniques to gather, analyze, and interpret data.”*
- *“Develop description, explanation, predictions, and models*

## Mathematics Standards

*For a comprehensive alignment to the NCTM Standards and Expectations, see Appendix B and Appendix C of this document.*

*using evidence.”*

- *“Think critically and logically to make the relationships between evidence and explanations.”*

Each “Smart Skies” Curriculum Supplement also supports many of the National Council of Teachers of Mathematics (NCTM) Standards and Expectations for Grades 5-8.

Particular emphasis is placed on content standards and expectations from Algebra (Grades 3-5 and 6-8), Geometry (Grades 3-5), Measurement (Grades 6-8), and Data Analysis and Probability (Grades 3-5) as follows:

*(Algebra 3-5) Students “model problem situations with objects and use representations such as graphs, tables, and equations to draw conclusions.”*

*(Algebra 3-5) Students “identify and describe situations with constant or varying rates of change and compare them.”*

*(Algebra 6-8) Students “model and solve contextualized problems using various representations, such as graphs, tables, and equations.”*

*(Algebra 6-8) Students “use graphs to analyze the nature of changes in quantities in linear relationships.”*

*(Geometry 3-5) Students “describe location and movement using common language and geometric vocabulary.”*

*(Geometry 3-5) Students “make and use coordinate systems to specify locations and to describe paths.”*

*(Geometry 3-5) Students “create and describe mental images of objects, patterns, and paths.”*

*(Measurement 6-8) Students “solve simple problems involving rates and derived measurements for such attributes as velocity and density.”*

*(Data Analysis and Probability 3-5) Students “collect data using observations, surveys, and experiments.”*

*(Data Analysis and Probability 3-5) Students “represent data using tables and graphs such as line plots, bar graphs, and line graphs.”*

Each Curriculum Supplement also supports the NCTM process standards (Grades 3-5 and 6-8) for Problem Solving, Communication, Connections, and Representation:

*(Problem Solving 3-5 and 6-8) Students “solve problems that arise in mathematics and other contexts.”*

*(Problem Solving 3-5 and 6-8) Students “apply and adapt a variety of strategies to solve problems.”*

*(Communication 3-5 and 6-8) Students “communicate their mathematical thinking coherently and clearly to peers, teachers, and others.”*

*(Connections 3-5 and 6-8) Students “recognize and apply mathematics in contexts outside of mathematics.”*

*(Representation 3-5 and 6-8) Students “select, apply, and translate among mathematical representations to solve problems.”*

*(Representation 3-5 and 6-8) Students “use representations to model and interpret physical, social, and mathematical phenomena.”*

## **Assessment**

Each of the eight “Smart Skies” Curriculum Supplements includes pre- and post-test assessment instruments that address the following learning objectives that reflect the national science and mathematics standards.

### **Science**

Students will:

- Use data to construct an explanation of an airspace problem.
- Use evidence to put forth predictions, explanations, and models of an airspace problem.
- Measure and represent motion on a graph.

### **Mathematics**

Students will:

- Solve an airspace problem involving rates of change.
- Model and solve an airspace problem using a variety of representations such as graphs, tables, and equations.
- Communicate their mathematical thinking.

## IMPLEMENTATION

### Implementing a “Smart Skies” Curriculum Supplement

*You may choose to spread the experiment and calculation activities over two or three class periods, allowing time for setting up the experiment, conducting the experiment, doing the calculations, and discussing the outcomes.*

*You can choose which paper-and-pencil activities to assign.*

### CD-ROM

Estimated time:  
30 minutes

Each Curriculum Supplement consists of an experiment, worksheets to support the experiment, worksheets for paper-and-pencil calculations, a student analysis of the airspace scenario, and optional pre- and post-assessment instruments. The eight Curriculum Supplements are accompanied by a CD-ROM on air traffic control.

Each Curriculum Supplement is accompanied by a full set of solutions and as well as a Teacher Guide with suggestions for implementing the specific airspace scenario.

The following sequence is recommended for implementing each “Smart Skies” Curriculum Supplement:

- If your students are new to “Smart Skies”, begin with the CD-ROM introduction to air traffic control.
- (Optional) Administer the pretest.
- Have your students set up and conduct the classroom experiment.
- Assign a paper-and-pencil mathematics activity to guide your students through calculations that support the experiment.
- Assign the analysis activity to help your students compare their experimental results with their calculations.
- (Optional) Administer the post-test.

Each of the six components is now described in greater detail as follows.

### See Air Traffic Controllers on the Job

The *Gate to Gate* CD-ROM (produced by NASA and the FAA) introduces students to the people who operate the federal air traffic control system and exposes students to the tools the controllers use.

The CD-ROM is divided into seven segments that correspond to the seven phases of an airplane journey from San Francisco to New York. To access a particular segment, click the corresponding airplane icon located on the circle on the *Gate to*

Gate home screen.

If time is limited, you might direct your students to view only Segment 4 (En Route) and Segment 5 (Descent).

The CD-ROM viewing may be conducted as an individual, a small-group, or a whole-class activity.

### **Materials**

Gate to Gate CD-ROM

PC or Mac

## **Pretest**

Estimated time:  
15 - 30 minutes

*The pretest is **optional**.*

*Instead of distributing the pretest, you may want to use the questions to guide a classroom discussion.*

### **Pretest—Make a Prediction**

The pretest steps the student through a careful reading of the airplane problem statement. The student is then asked to predict the outcome of the given airplane scenario.

The pretest may be assigned as either an individual or a small-group activity.

If your students have completed other “Smart Skies” Curriculum Supplements, you may want to direct them to use a particular calculation method or methods to answer the pretest questions. An optional worksheet supplies blank vertical line plots and grids that students can use as they do their calculations.

### **Materials**

Worksheet: Pretest—Make a Prediction

Worksheet: Lines and Grids (optional)

## **Experimentation**

Estimated time:  
Setup—30 minutes  
Experiment—30 minutes

*For a step-by-step orientation to the Experiment, see Curriculum Supplement 0, the introduction to **Airspace Systems**.*

### **Classroom Experiment**

In this small-group activity, students set up the experiment by marking off the jet routes on the classroom floor or on an outdoor area. To conduct the experiment, students assume the roles of pilots, air traffic controllers, and NASA scientists. The pilots step down the jet route at a prescribed pace. The NASA scientists track and record the pilots’ times and the pilots’ distances from the intersection of the routes (Curriculum Supplements 1-6) or distances along the jet route (Curriculum Supplements 7-8). The air traffic controllers set the pace and measure the separation distance when the first plane arrives at the intersection.

### **Materials**

Set Up the Experiment

--sidewalk chalk or masking tape

--measuring tape or ruler



*You may want to give students an overview of the experiment including an explanation of what they will do in each activity.*

*You may want to ask your students to compare the experiment distances and speeds with the real-world speeds given in the Teacher Guide for each Curriculum Supplement.*

*You may want to ask your students to estimate the route layout before they measure.*

*If your classroom has 1-foot by 1-foot floor tiles, your students can use the tiles as guidelines for placing masking tape at the appropriate intervals along the jet route.*

*It may be difficult for some student pilots to take 6-inch (or 4-inch or 3-inch) steps by placing one foot in front of the other. Instead, advise the pilots to place one foot on either side of the jet route and align their toes at each mark. It may be helpful for students to practice.*

--marking pens (optional)

### Conduct the Experiment

--1 stopwatch or 1 watch with a sweep second hand or 1 digital watch that indicates seconds

--pencils and Data Sheets

--signs identifying pilots, controllers, and NASA scientists

Note: the signs are available on the Smart Skies website.

--clipboard (optional)

### Student Handouts

--Worksheet: Set Up the Experiment

--Worksheet: Conduct the Experiment

--Worksheet: Data Sheet

### Worksheet: Set Up the Experiment

Curriculum Supplements 1-6 require two jet routes. If there is not enough room to set up two routes (a 20-foot route and a 16-foot route) at right angles to one another, another angle may be used. As an alternative, the routes may be set up parallel to each other. (Caution: parallel routes may confuse students who have not had much experience with the experiment. They may not make the connection between the parallel routes and the given merging routes.) In any case allow enough distance between the routes so that the two pilots are not distracted by one another.

You may want to set up one pair of jet routes as a model that your students can copy.

After a group of students has completed its jet route set-up, you may find it helpful to have them compare their work with another student set-up.

### Worksheet: Conduct the Experiment

Assign students to positions on 6-8 person teams as follows:

--Lead Air Traffic Controller (1 student)

--Secondary Air Traffic Controller (1 student)

--Pilots (2 students)

--NASA Scientists, 1 or 2 for each plane (2 – 4 students)

After the jet routes are set up, have one group of students demonstrate the experiment while the rest of the class observes. Discuss and address any issues that may arise.

Perform the activity at least three times. Compare the results of each trial. Discuss the validity of the results.

**Extensions:**

1. Repeat the activity using different students as the Air Traffic Controllers, Pilots, and NASA Scientists.
2. Repeat the activity using jet routes longer than 20 feet. Increase the plane speed and the step size to 1 foot/second.
3. Have students draw a scale model of the experiment using real-world data found in the Teacher Guide for each Curriculum Supplement.

**Calculations**

Estimated time:  
15 - 30 minutes per  
worksheet

**Calculate the Time for Each Plane**

This activity presents six different methods students can use to determine the number of seconds:

- for each plane to arrive at the point where their routes merge (Curriculum Supplements 1-6)
- for the trailing plane to catch up with the leading plane (Curriculum Supplements 7-8).

The calculation methods range in order of difficulty as follows:

Counting (completing a table)  
Drawing blocks to make a bar graph  
Plotting points on two vertical lines  
Plotting points on a Cartesian coordinate system  
Deriving and using the distance-rate-time formula  
Graphing two linear equations

This table indicates the range of appropriate grade levels for each method:

	<i>Grade:</i>			
<i>Method:</i>	5	6	7	8
Counting	x	x		
Blocks	x	x	x	x
Vertical Line Graph	x	x	x	x
Cartesian Plot	x	x	x	x
Formula	x	x	x	x

*You can choose to assign one, some, or all of the worksheets.*

*You may want to assign some worksheets before and some worksheets after the experiment.*

## Graphing Two Equations

x      x      x      x

Each method is presented on a separate worksheet.

Each worksheet may be assigned as either an individual or a small-group activity.

You may choose to start your students with the Vertical Line Graph worksheet. If your students need more support, you can choose the Counting worksheet or the Blocks worksheet. If your students need a greater challenge, you can choose the Cartesian Plot worksheet, the Formula worksheet, or the Graphing Two Equations worksheet.

Each method is described briefly as follows.

### Count Feet and Seconds

Students use patterns and skip-counting to complete a table and solve the problem. At the end of this activity, students may realize it is faster to multiply than to add to obtain the answers.

Prerequisite skills: skip-counting by 2's and/or 3's (depending upon the problem)

### Draw Blocks

For each plane, students draw blocks, each representing the distance the plane travels in 10 seconds. The students "stack" their blocks along a vertical number line that represents the plane's jet route.

Each vertical line is numbered with 0 at the top. For each plane, students begin to stack the blocks at the plane's starting point located at the bottom of a vertical line. The end of the route is represented with 0 at the top of the number line.

Prerequisite skills: read and build a bar graph with a vertical scale marked in 1-foot units; count by 10s.

### Plot Points on a Vertical Line

This graph is similar to the way families record and compare the height of their children at the same ages. They mark off each child's birthday height (distance from the floor) on a doorway and then record their age (time since birth) beside the height mark.

For each plane, students plot their points along a vertical number line that represents the plane's jet route.

The vertical line is numbered with 0 at the top. The bottom of the number line represents the starting point of the plane. The end of the route is represented with 0 at the top of the number line.

Prerequisite skills: plot a point on a (vertical) number line.

### Plot Points on a Cartesian Coordinate System

The points are plotted in the fourth quadrant. So the displayed portion of the y-axis is numbered with 0 at the top.

Prerequisite skills: plot a point on a Cartesian coordinate system (the xy-plane)

### Derive and Apply the Distance-Rate-Time Formula

First, students use patterns to derive the distance-rate-time formula in the form  $d = rt$ .

Prerequisite skills:  
Use patterns to make a generalization.

Then students apply the distance-rate-time formula in the form  $t = d/r$ .

Prerequisite skills:  
Substitute numbers into a formula.

### Graph Two Linear Equations

The points are plotted in the fourth quadrant. So the displayed portion of the y-axis is numbered with 0 at the top.

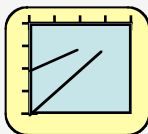
Students are asked to find the slope of each line and interpret that number in the context of the airspace problem.

Prerequisite skills:  
Graph a linear equation by making a table of ordered pairs.  
Find the slope of a line given the equation of the line and the graph of the line.

### Extension (optional):

$$d = r \cdot t$$

$$t = d / r$$



*Caution: Students may confuse the path of a plane with the graph of the plane's distance from the intersection as a function of time.*

You may want to ask your students to find the intercepts of each line and interpret those intercepts in the context of the airspace problem.

### **Materials**

Worksheet: Calculate the time—count feet & seconds

Worksheet: Calculate the time—draw blocks

Worksheet: Calculate the time—plot on two vertical  
scales

Worksheet: Calculate the time—plot points on a Cartesian  
coordinate system

Worksheet: Derive the Distance-rate-time formula

Worksheet: Use the Distance-rate-time formula

Worksheet: Graph Two Linear Equations

## **Analysis**

Estimated time:  
45 minutes

*You may want to assign  
some other calculation  
worksheets to give students  
another basis for  
comparison.*

## **Compare the Experimental Results with the Predicted Results**

This activity may be assigned as either an individual or a small-group activity.

After your students have completed the experiment and at least one of the calculation worksheets, you may want to ask them to compare the results of the experiment with the results of their calculations. If the results are different, you may want to ask the students why the experiment and their calculations do not match.

As part of the Analysis, you may also want to ask your students to create a similar problem in a different setting. For example, your students might create a similar problem involving two cars (rather than two planes).

The Analysis also guides students through a generalization of the given airspace scenario.

Note: To be consistent with the airspace scenarios, it is important that for each problem created by you or your students, you choose a fixed (constant) speed for each vehicle or person. (For example, a rocket launch scenario would *not* be appropriate because a launched rocket typically accelerates and therefore its speed is not constant.)

### **Materials**

Worksheet: After the Experiment

## **Posttest**

Estimated time:

## **Curriculum Supplement Posttest**

15 - 30 minutes

*The posttest is **optional**.*

This activity may be assigned as either an individual or a small-group activity.

You may want to direct your students to use a particular calculation method or methods to answer the posttest questions. An optional worksheet supplies blank vertical line plots and grids that students can use as they do their calculations.

**Materials**

Worksheet: Posttest

Worksheet: Lines and Grids (optional)

## **SUPPORT**

### **Assistance**

If you have questions about the “Smart Skies” Curriculum Supplements, send an e-mail message to:

[smartskies@mail.arc.nasa.gov](mailto:smartskies@mail.arc.nasa.gov)

## Appendix A

### Alignment of Airspace Systems to the

### National Science Education Standards (NSES) for Grades 5-8

<b>Science Content Standard</b>	<b><i>Airspace Systems Activity</i></b>
<b>Science as Inquiry</b>	
Design & conduct a scientific investigation.	--Conduct simulation and measurement for several aircraft conflict problems.
Use appropriate tools and techniques to gather, analyze, and interpret data.	--Conduct simulation and measurement for several aircraft conflict problems.
Develop descriptions, explanations, predictions, and models using evidence.	--Use calculations and experimental evidence to predict, describe, and explain several aircraft conflict problems.
Think critically and logically to make the relationships between evidence and explanations.	--Compare predictions, calculations, and experimental evidence for several aircraft conflict problems.
<b>Physical Science</b>	
<b>Motion and Forces</b>	
As a result of their activities in grades 5-8, all students should develop an understanding of motions and forces.	
The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.	--Calculate and measure the position and time of simulated aircraft. Represent that motion using tables, graphs, equations, and experimentation.



## Appendix B

### Alignment of Airspace Systems to the

### National Council of Teachers of Mathematics (NCTM)

### Standards and Expectations for Grades 3-5

<b>Mathematics Standard &amp; Expectations</b>	<b><i>Airspace Systems Activity</i></b>
<b>Algebra</b>	
Use mathematical models to represent and understand quantitative relationships.	
Model problem situations with objects and use representations such as graphs, tables, and equations to draw conclusions.	<p>--Represent distance, speed, and time relationship for constant speed cases using tables, bar graphs, line graphs, equations, and a Cartesian coordinate system.</p> <p>--Use tables, bar graphs, line graphs, equations, and a Cartesian coordinate system to draw conclusions.</p>
Identify and describe situations with constant or varying rates of change and compare them.	--Compare airspace scenarios for both the same and different starting conditions and the same and different rates.
<b>Geometry</b>	
Specify locations and describe spatial relationships using coordinate geometry and other representational systems.	
Describe location and movement using common language and geometric vocabulary.	--Explain and justify solutions regarding the motion of two airplanes using the results of plotting points on a schematic of a jet route, on a vertical line graph, and on a Cartesian coordinate system.
Make and use coordinate systems to specify locations and to describe paths.	--Plot points on a schematic of a jet route, on a vertical line graph, and on a Cartesian coordinate system to describe the motion of two airplanes.
Use visualization, spatial reasoning, and geometric modeling to solve problems.	
Create and describe mental images of objects, patterns, and paths.	--Predict the relative motion of two airplanes on given paths.
<b>Data Analysis and Probability</b>	
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.	
Collect data using observations, surveys, and experiments.	--Conduct a simulation of each airplane scenario.

<b>Mathematics Standard &amp; Expectations</b>	<b><i>Airspace Systems Activity</i></b>
Represent data using tables and graphs such as line plots, bar graphs, and line graphs.	--Represent distance, rate, and time data using line plots, bar graphs, and line graphs.
<b>Problem Solving</b>	
Solve problems that arise in mathematics and other contexts.	--Apply mathematics to predict and analyze aircraft conflicts and validate through experimentation.
Apply and adapt a variety of strategies to solve problems.	--Use tables, graphs, and equations to solve aircraft conflict problems.
<b>Communication</b>	
Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.	--Predict outcomes and explain results of mathematical models and experiments.
<b>Connections</b>	
Recognize and apply mathematics in contexts outside of mathematics.	--Apply mathematics to solving distance, rate, and time problems for aircraft conflict scenarios.
<b>Representation</b>	
Select, apply, and translate among mathematical representations to solve problems.	--Choose among tables, bar graphs, line graphs, a Cartesian coordinate system, and equations to model aircraft conflicts and predict outcomes.
Use representation to model and interpret physical, social, and mathematical phenomena.	--Use tables, bar graphs, line graphs, a Cartesian coordinate system, and equations to model aircraft conflicts and predict outcomes.

## Appendix C

### Alignment of Airspace Systems to the

### National Council of Teachers of Mathematics (NCTM)

### Standards and Expectations for Grades 6-8

<b>Mathematics Standard &amp; Expectations</b>	<b><i>Airspace Systems Activity</i></b>
<b>Algebra</b>	
Use mathematical models to represent and understand quantitative relationships.	
Model and solve contextualized problems using various representations, such as graphs, tables, and equations.	--Represent distance, speed, and time relationship for constant speed cases using tables, bar graphs, line graphs, equations, and a Cartesian coordinate system.  --Use tables, bar graphs, line graphs, equations, and a Cartesian coordinate system to draw conclusions.
Analyze change in various contexts.	
Use graphs to analyze the nature of changes in quantities in linear relationships.	--Use graphs to compare airspace scenarios for both the same and different starting conditions and the same and different constant (fixed) rates.
<b>Measurement</b>	
Apply appropriate techniques, tools, and formulas to determine measurements.	
Solve simple problems involving rates and derived measurements for such attributes as velocity and density.	--Use the distance-rate-time formula to predict and analyze aircraft conflicts.
<b>Problem Solving</b>	
Solve problems that arise in mathematics and other contexts.	--Apply mathematics to predict and analyze aircraft conflicts and validate through experimentation.
Apply and adapt a variety of strategies to solve problems.	--Use tables, graphs, and equations to solve aircraft conflict problems.
<b>Communication</b>	
Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.	--Predict outcomes and explain results of mathematical models and experiments.
<b>Connections</b>	
Recognize and apply mathematics in contexts outside of mathematics.	--Apply mathematics to solving distance, rate, and time problems for aircraft conflict scenarios.
<b>Representation</b>	
Select, apply, and translate among mathematical	--Choose among tables, bar graphs, line

<b>Mathematics Standard &amp; Expectations</b>	<b><i>Airspace Systems Activity</i></b>
representations to solve problems.	graphs, a Cartesian coordinate system, and equations to model aircraft conflicts and predict outcomes.
Use representation to model and interpret physical, social, and mathematical phenomena.	--Use tables, bar graphs, line graphs, a Cartesian coordinate system, and equations to model aircraft conflicts and predict outcomes.